

VIII.—*Contributions to the Study of the chief Generic Types of the Palaeozoic Corals.* By JAMES THOMSON, F.G.S., and H. ALLEYNE NICHOLSON, M.D., D.Sc., F.R.S.E., Professor of Natural History in the University of St. Andrews.

[Continued from vol. xvii. p. 462.]

[Plates I.-III.]

Genus RHODOPHYLLUM, Thomson.

Rhodophyllum, Thomson, Geol. Mag. dec. 2, vol. i. p. 557, pl. xx.

Gen. char. Corallum simple, cono-cylindrical, usually tall and more or less curved. Epitheca thin, complete, with well-marked annulations of growth. Calice circular, shallow, its edges more or less everted, exhibiting in the centre of its floor a dome-shaped or rounded boss, which is but slightly raised above the inner margins of the primary septa. The surface of the boss is marked by a number of spirally twisted ridges, which proceed from its margins to its summit, where there is no distinct median crest or keel. Septa well developed, of two orders, the primary never extending further inwards than the outer margin of the central boss, and the secondary septa being considerably shorter and sometimes hardly recognizable. Internal structure triareal. Central area ("interlamellar space") formed by the intersection of a series of remote and irregular, twisted, vertical lamellæ with a series of irregular and vesicular tabulæ. As seen in transverse sections, the intersection of these two series of plates gives rise to a number of lines which, though irregular, are in the main folded in a spiral or contorted manner round an imaginary centre. The central area is not partially or wholly divided into two parts by any predominant lamella; nor are the vertical lamellæ regularly arranged in a radiating manner from the circumference of the central area towards its centre. The intermediate area ("interocular area") is composed of nearly horizontal loosely anastomosing tabulæ; and the inner lamellar ends of the primary septa extend into it. The outer area ("interseptal area") is occupied by the septa, which in this portion of the corallum are delicate and flexuous, and are united together by very numerous, close-set, anastomosing dissepiments. There is thus produced an exterior zone of dense vesicular tissue, the vesicles of which are arranged in oblique rows directed upwards and outwards. Longitudinal sections show that the central area is intersected by several discontinuous, and often wavy columellarian lines; and cross sections exhibit a well-marked septal fossula.

The genus *Rhodophyllum* agrees with the genera *Clisio-phyllum*, *Dibunophyllum*, and *Aspidophyllum* in the following

characters:—(1) There is a large central area, the free end of which projects above the floor of the calice as a central eminence or boss (Pl. I. fig. 4). This central area is formed, on the one hand, by vertical lamellæ, the free ends of which appear as so many ridges on the surface of the boss, and, on the other hand, by a series of closely approximated tabulæ, the cut edges of which appear in cross sections as so many concentric lines. The cut edges of the vertical lamellæ appear in cross sections as so many lines directed in general from the margins of the central area towards its centre. (2) A narrow but well-marked intermediate area (Pl. I. fig. 3 A) exists, which is constituted principally by a series of horizontal anastomosing tabulæ, and into which the inner extremities of the primary septa are prolonged. (3) There exists a more or less extensively developed exterior zone (Pl. I. fig. 3 A), which is formed by the intersection of the septa with a series of very numerous and closely arranged dissepiments. As seen in longitudinal sections, this area presents itself as a zone of dense vesicular tissue, formed by minute lenticular cells, the convexities of which look upwards, and which are arranged in oblique rows directed upwards and outwards. (4) The primary septa (Pl. I. figs. 1–3) appear as strong and thick lamellæ in the intermediate area of the corallum, where they are united by a few remote dissepiments; but they never extend into the central area, with the vertical lamellæ of which they are not connected in any way, save here and there by the intervention of delicate twisted plates. In the exterior zone the septa are very much more delicate, they become more or less flexuous, and they can only be traced with difficulty through the dense vesicular tissue formed by the dissepiments.

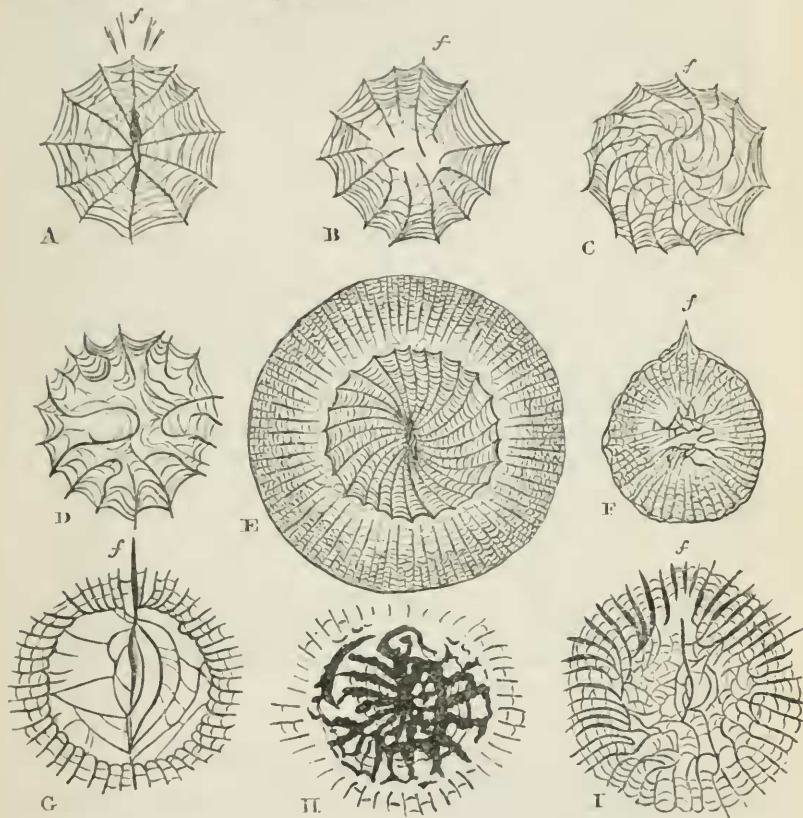
It is in the structure of the central area of the corallum that *Rhodophyllum* exhibits its distinctive peculiarities; and these, in our opinion, are sufficient to separate the genus from *Clisiophyllum* and from its immediate congeners. These peculiarities are as follows:—(1) The calicine boss is rounded, not conical, and of no great height, and exhibits no median crest, partial or complete; its surface is marked with spirally twisted ridges, which ascend from its margins to its summit. (2) As seen in longitudinal sections (Pl. I. fig. 3 A, Pl. II. figs. 1 A & 3), the tabulæ are found to be intersected by more or fewer broken and discontinuous vertical columellarian lines. Though in the main elevated towards the middle line, the tabulæ intercepted between any successive pair of these columellarian lines are more or less concave, and have their concavities directed upwards. (3) As exhibited in transverse sections, the central area does not display the complete mesial partition of *Dibunophyllum*, or the partial one of *Aspidophyllum*;

nor does it show a regular series of lines representing the cut edges of the vertical lamellæ, and radiating from the circumference to the centre, such as is present in both of the above genera and also in *Clisiophyllum*. On the contrary, we find in *Rhodophyllum* (Pl. I. figs. 1-3) a series of lines, of a wavy and irregular character, but upon the whole twisted in a convolute or contortive manner round an imaginary centre. These spirally twisted lines are formed partly by the cut edges of the vertical lamellæ of the central area, and partly by the cut edges of the tabulæ of the same region. In fact, the vertical lamellæ of the central area may be regarded as being comparatively rudimentary, as compared with their development in *Clisiophyllum*, *Dibunophyllum*, and *Aspidophyllum*.

The four groups which we have now considered under the names *Clisiophyllum*, *Dibunophyllum*, *Aspidophyllum*, and *Rhodophyllum* form four natural assemblages which are most intimately related in the fundamental plan of their organization. Though their morphological type is substantially the same, and though transitional and intermediate forms are not wanting, each of these groups is nevertheless distinguished from the others by special structural peculiarities, of such constancy and of such importance that they may be best indicated by special titles. To this conclusion we have been led after a careful examination and comparison of several hundreds of cut and polished specimens, and of thin sections prepared for the microscope. That the course which we have been led to adopt may not recommend itself to others is quite possible. We are most willing to admit that it must remain in the meanwhile a matter of opinion whether such differences as we have endeavoured to indicate as existing amongst the Clisiophylloid corals are of *generic* or *subgeneric* value, or even whether each type might not rather be considered as constituting a single, extremely variable *species*. This point can only be decided by the opinion of each individual observer; and its decision will inevitably depend more or less upon the views which each individual may hold as to what ought to be understood by the terms "genera," "subgenera," and "species." With regard to the actual *existence* of the different groups which we have described, we can confidently appeal to the facts of nature: whether our interpretation of these facts be correct or not is a matter of comparatively small moment.

As the series of related and inosculating groups, of which *Clisiophyllum* is the central form, is one of great complexity, and presenting unusual difficulties in its study, we introduce here diagrams by which the leading differences of these groups may be readily apprehended (see p. 71). In all these forms (save the aberrant genus *Carcinophyllum*) the structure of the external

and intermediate areas of the corallum is essentially and fundamentally identical. They differ, however, in the structure of the great mass of endothecal tissue which occupies the centre of the visceral chamber; and these differences are shown in the annexed sketches, where the structure of the central area of these forms is represented.



Diagrams showing the structure of *Clisiophyllum* and its allies. A, *Dibunophyllum*; B, *Aspidophyllum*; C, *Rhodophyllum*; D, type intermediate between *Aspidophyllum* and *Rhodophyllum*; E, *Clisiophyllum*; F, *Cyclophyllum*; G, transition-form between *Koninkophyllum* and the typical *Clisiophylloids*; H, *Carcinophyllum* (gen. nov.); I, transition-form, near G. Fig. E represents a cross section of *Clisiophyllum coniseptum*, Keys., of the natural size, in which the external and intermediate areas are introduced as well as the central. Figs. A, B, C, D, and F are enlarged, and represent only the central area of the corallum; to complete these figures, an external and intermediate zone must be added, as in fig. E. Figs. G, H, and I are likewise enlarged, and represent the central area of the corallum, along with the inner ends of the septa. The letter *f* indicates the position of the fossula.

The genus *Rhodophyllum*, so far as our present knowledge goes, is exclusively confined to the Carboniferous period, and it has not hitherto been recognized out of Scotland. Though very readily recognized in typical examples, it is, as before said, united with its immediate allies by transitional forms. The best-marked of these intermediate groups is to be found between typical examples of *Rhodophyllum* on the one hand, and *Aspidophyllum* on the other hand. The figures in Plate III. represent longitudinal and transverse sections of this intermediate and transitional type. In this group the vertical lamellæ of the central area do not exhibit that contortive arrangement which is so characteristic of *Rhodophyllum*, but they are generally seen in transverse sections (diagr. D) as irregular, more or less wavy lines, often uniting with one another in a series of undulating curves, the convexities of which are directed centrally. There is no single predominant vertical lamella, such as exists in *Aspidophyllum*; but the cut edges of the tabulæ are seen in transverse sections to have much the same arrangement as in the latter genus, being strongly curved, and having their convexities directed inwards. In longitudinal sections (Pl. III. figs. 1 & 5 A), the central area is seen to be occupied with anastomosing and closely vesicular tabulæ, intersected by several irregular and discontinuous vertical lines, representing the cut edges of the vertical lamellæ.

EXPLANATION OF THE PLATES.

[Unless otherwise stated, all the figures are of the natural size. In these three plates we have tried the experiment of printing the figures in white upon a black ground. It may be questioned, however, if the results are quite so satisfactory as in the ordinary method of printing in black on a white ground.]

PLATE I.

- Fig. 1.* *Rhodophyllum Slimonianum*, Thomson, transverse section. Lower Carboniferous, Brockley, near Lesmahagow.
Fig. 2. *Rhodophyllum Phillipsianum*, Thomson, transverse section. Lower Carboniferous, Trearne, near Beith, Ayrshire.
Fig. 3. *Rhodophyllum Craigianum*, Thomson, transverse section; 3 A, longitudinal section of the same. Lower Carboniferous, Trearne, near Beith, Ayrshire.
Fig. 4. *Rhodophyllum simplex*, Thomson, interior of an imperfect calice, showing the form of the central boss; 4 A, transverse section of the same. Lower Carboniferous, Brockley, near Lesmahagow.

PLATE II.

- Fig. 1.* *Rhodophyllum Phillipsianum*, Thomson, transverse section; 1 A, longitudinal section of the same. Lower Carboniferous, Langside, near Beith, Ayrshire.

Fig. 2. Transverse section of a young form of *Rhodophyllum*. Lower Carboniferous, Brockley, near Lesmahagow.

Fig. 3. *Rhodophyllum*, sp., longitudinal section, showing the densely vesicular character of the central area; 3 A, transverse section of the same. Lower Carboniferous, Langside, near Beith, Ayrshire.

PLATE III.

Figs. 1-7. Transverse and longitudinal sections of a group of forms transitional between *Rhodophyllum* and *Aspidophyllum*. Lower Carboniferous, Brockley, near Lesmahagow; Thirdpart and Langside Quarries, near Beith, Ayrshire.

MISCELLANEOUS.

On the Embryology of the Nemertina. By M. J. BARROIS.

I HAVE already disputed the line of demarcation hitherto established between the two kinds of development of the Nemertina (development by the differentiation of a *Morula*, and development by the coalescence of four discoidal plates); I have shown that the four suckers of Müller were not, as has always been supposed, peculiar to the *Pilidium*, but that they occurred in types hitherto regarded as originating from the direct differentiation of the *Morula*.

Soon afterwards I succeeded in discovering the true signification of the four suckers; I found that *the two anterior suckers constitute the cephalic muscular masses, and the two posterior the delicate laminae which form the wall of the body.*

This statement is exceedingly important; for we find in the development of all the Nemertians, even of those in which the development is most simple, a stage in which there is a clear division into two cavities, round each of which the various parts just mentioned are formed, between the two the lateral organs and the œsophagus; round the first the cephalic masses, and round the second the laminae of the wall of the body. In the Enopla this division into two cavities is, from the first, very distinct. It is in the Anopla with a simpler development, such as *Cephalothrix*, that the matter is most difficult of recognition. In consequence of a peculiarity of structure belonging to this group, the two cavities appear in it, from the first, united into a single one; nevertheless it is not difficult, especially after the differentiation of the two great divisions of the musculature, to recognize without hesitation their distinct existence.

The constant and universal occurrence of this important stage, whatever the group may be, enables us easily, starting from this common point, to trace the divergences which give rise to the two great divisions of the Anopla and the Enopla.

Two phenomena are necessary to form one of the Anopla:—1. The lateral organs detach themselves from the œsophagus, and the pro-